us at present, and brought into harmony with the other facts bearing upon the question of coagulation. Still, they are thus far real difficulties, and should not be lost sight of in the discussion of so important a physiological problem.

In the Appendix, the author treats at some length of various pathological conditions connected with the subject of the treatise—such as the super-alkalinity of the blood, and consequent want of coagulability; of the deposition of fibrin in the form of concretions in the vascular system during life, and of the symptoms and accidents to which it may give rise; of the acids and alkalies as remedial agents in such conditions; of the normal exhalation of ammonia from the body, particularly as an ingredient of the breath; and of some conditions of the blood after death in relation to medico-legal inquiries.

In the chapter on the *Phenomenon of the Buffy Coat*, there occurs the following singular specimen of scientific kite-flying—the more remarkable for its contrast with the generally solid and substantial character of the contents of the treatise.

> "If I venture, in fine," says the author, "to speak of inflammatory blood as blood in which the oxidation process is abnormally active, or let fall the suggestion that in this state the iron inclosed in the blood-cells may possibly have become the magnetic oxide, and that the rapid aggregation of these cells in inflammatory blood has thus some relation to the magnetic force, I do so open to the correction of more extended observation."

We do not know how far the pathological and therapeutical portions of Dr. Richardson's essay will be regarded as advancing the condition of practical medicine; but as a contribution to physiological science, it is certainly a work of no ordinary value. J. C. D.

Art. XXI.—*On Malformations, &c., of the Human Heart. With original cases.* By Thomas B. Peacock, M. D., Fellow of the Royal College of Physicians, Assistant Physician to St. Thomas's Hospital, and Physician to the Hospital for Diseases of the Chest, Victoria Park. London: John Churchill, New Burlington Street, 1858, 8vo., pp. 143.

The various malformations to which the heart is subject, constitute a study interesting in itself, and important, as well as interesting, in its relations to the physiology of the circulation, and to embryology. Nor is this study devoid of direct practical bearings. It is desirable for the practitioner to recognize the existence of these malformations by means of signs and symptoms during life, and, so far as diagnostic criteria are available, discriminate between them. Moreover, the histories of cases, taken in connection with the appearances after death, furnish information respecting the effects of derangements of the circulation incident to the various malformations, which may be usefully applied to elucidate the phenomena of disease.

This small volume contains the substance of a series of lectures delivered by Dr. Peacock, at St. Thomas's Hospital, in 1854, and subsequently published in the *Medical Times and Gazette.* In the present publication the form of lectures is dropped, and the whole has been carefully revised and considerably extended. The author gives cases illustrative of the different forms of malformation, many being selected from the instances which have come under his own observation. Reference is made to analogous cases reported by different observers in different countries. Some of the most interesting forms of malformations are represented by well executed lithographic plates.

The author's classification is based on distinctions which, in themselves, involve a philosophical view of the subject. He arranges the different malformations into four classes, as follows: 1. Congenital misplacements of the heart. 2. Deficiency of the pericardium. 3. Malformations of the heart, including—1st, malformations dependent on arrest of development at an early period of fœtal life; 2d, malformations preventing the changes which should come after birth; and, 3d, malformations which do not interfere with the functions of the heart, but may lay the foundation of disease in after life. 4. Malformations consisting in the irregular development of the primary vessels. So little attention is bestowed on this field of study by medical practitioners in general, and it occupies so little space in medical literature, that we trust our readers will not find fault with us for noticing briefly some of the points of interest relating respectively to these divisions.

The misplacements of the heart are either of *transposition* or *exposition.* Instances in which the organ is situated in the right side of the chest are not so unfrequent but that numerous examples have been observed. In some of these instances other viscera are likewise transposed, but in other cases the latter occupy their natural positions. This abnormal situation of the heart is by no means incompatible with health and long life. It is desirable to distinguish between cases of this description and those in which the heart has been displaced by pleuritic effusion, and retained its malposition after the effusion has been absorbed. This discrimination is not always easy. We have met with a patient affected with tuberculosis in whom the heart was found to be situated on the right side of the sternum. The patient presented the signs of an ancient pleurisy on the left side, but the pleura, at the time of our examination, contained no liquid. It was a matter of doubt in this case, whether congenital malposition existed, or whether the heart had been dislocated by the accumulation in the pleura, which had existed at some former period, and, forming attachments, was prevented by these from resuming its normal position after the pleuritic accumulation had disappeared. We have been informed that a highly distinguished American medical writer presented the anomaly of the heart being contained in the right side of the chest.[1] In cases of *exposition,* the heart may be situated exterior to the chest (*ectopia pectoralis cordis*). Such instances are exceedingly rare, unless, at the same time, the viscera of the abdomen are protruded. In none of the cases cited by the author, in which the heart alone was exterior to the chest, did life continue over forty hours after birth. These cases offer valuable opportunities for studying the movements of the heart by means of the sight and touch. In other cases the heart is situated below the diaphragm, and in these cases there may, or may not, be an external tumour. This form of malposition (*ectopia cordis ventralis*), is not incompatible with vigorous health. A case is cited of a soldier in whom the heart occupied the place of the right kidney; the patient died of disease of the kidney, and intra-pelvic tumour. A very curious abnormal situation of the heart included under this head, is in the front of the neck (*ectopia cordis cephalica*). Several cases of this malposition have been reported, in all of which the infants scarcely survived birth.

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[1] The late Dr. Elisha Bartlett.

Deficiency of the pericardium was described as an occasional abnormity by the older anatomists. It is highly probable that in some of the instances thus regarded, the pericardium was not really wanting, but was only apparently so, owing to unusual adhesion having taken place as a result of pericarditis. The pericardium, however, may undoubtedly be absent. Dr. Baillie described an instance in 1788, which came under his observation incidentally, the chest having been opened to explain to his class the situation of the thoracic viscera. The heart was bare and distinct, lying loose in the left cavity of the pleura. In this instance there had been no morbid symptoms referable to the heart during life. In several other examples given by the author, no troubles pertaining to the heart or circulation had existed. In one the patient died of the age of 75 years, with aortic valvular disease.

Malformations of the heart dependent on arrest of development at an early period of fœtal life, are the most numerous, and, in a scientific point of view, the most interesting. As many as ten authentic examples of biloculate heart, *i. e.* the heart consisting of an auricle and ventricle, have been reported by different observers. A few days constitute the duration of life compatible with this abnormity. The pulmonary vessels in these cases are given off by the aorta, and the systemic and pulmonary veins terminate in the single auricle. In this variety of malformation the arrest of development takes place early in fœtal life. Cases in which the heart consists of only three cavities are not so rare as the preceding. They denote an arrest of development occurring at a later period of intra-uterine existence. Persons with this malformation have lived for several years, but, in general, death takes place within a few weeks or months. The cavities are two auricles and a single ventricle, the latter presenting sometimes a rudimentary septum. These cases differ as respects the arrangement of the primary vessels. In some, both the aorta and pulmonary artery spring from the single ventricle; in others the aorta gives origin to the pulmonary vessels, or if the pulmonary artery exist, it is in a rudimentary form, and the blood is supplied to the lungs through the ductus arteriosus. Deficiency of the ventricular and auricular septa, separately or combined, is a variety of malformation vastly more common than the two varieties just noticed. When the ventricular septum is more or less deficient, the imperfection generally, but not invariably, exists at the base. The explanation of this is, the division of the cavities is here effected last during fœtal life. Hence, this form of malformation indicates an arrest of development, occurring at a period still later than in the two previous forms. In the fully developed organ there exists, at the upper part of the septum, a triangular space in which the ventricles are only separated by the endocardium and fibrous tissue on the left side, and by the lining membrane and a thin layer of muscular substance on the right. The average length of the sides of this triangle is about seven lines, and the base is somewhat wider. This is frequently distinguished as the *undefended space.* It has been a question with pathologists whether, in a certain proportion of the instances of deficiency of the interventricular septum at the point just referred to, it was not the result of rupture or perforation after birth. Bouillaud (the name is uniformly in the work spelled Bouilland) contends that it is frequently attributable to disease. The author concurs in the opinion that it is thus attributable in a certain proportion of cases, but in a smaller proportion than claimed by the French pathologist just named. Deficiencies in both the ventricular and auricular septa are usually associated with other defects, and especially with obstruction at the pulmonic orifice. Dr. Peacock attributes the former to the latter. The effects of pulmonic obstruction on the blood-currents prevents that complete separation of the cavities (exclusive of the foramen ovale) which should occur during the latter part of fœtal life. Considerable deficiency of the partitions between the ventricles or auricles is not uniformly attended by marked symptoms referable to the heart or circulation. The author refers to several instances illustrative of this fact, the patients presenting few or no indications of the existence of any heart affection. The reader will find a valuable collection of examples of these malformations described in the catalogue of the cabinet of the Boston Society for Medical Improvement. Instances exemplifying in a striking manner the fact just stated, are contained in that catalogue. If the deficiency in the septa be associated with mal-arrangement of the primary vessels, the consequences are far more serious. The pulmonary artery may, as well as the aorta, spring from the left ventricle. Virtually, in such an instance, the heart consists of three cavities. The left ventricle becomes greatly enlarged, and the right ventricle proportionably atrophied. Life has continued for years under these circumstances. In other instances the aorta, as well as the pulmonary artery, arises from the right ventricle. The pulmonic orifice in these instances is usually obstructed; the foramen ovale remains open, and the ductus arteriosus occasionally continues pervious. The various malformations falling under this head are illustrated by several cases given in full, and the appearances after death represented by plates. The author appends to his cases a long list of those contained in other publications.

Obliteration of the pulmonary artery would at first seem to be an abnormity incompatible with life. Several cases, however, have been reported in which death did not occur for several years. In connection with this malformation, the interventricular septum is often defective. The right ventricle becomes greatly dilated and hypertrophied. The ductus arteriosus generally remains pervious, and the pulmonary vessels are supplied through this channel. If the ventricular septum be complete, the foramen ovale continues open. As the author remarks, the open foramen ovale and the defect in the septum between the ventricles, instead of adding to the danger, afford relief to the overloaded right auricle and ventricle, without which it would be impossible for life to be prolonged, except for a very brief period.

The presence of a supernumerary septum in the right ventricle constitutes another variety of malformation. This superfluous septum may be so far complete that the heart appears to have three ventricles. In its effects this malformation is essentially similar to those involving obstruction or obliteration of the pulmonic orifice; with the latter, indeed, it is often associated. The foramen ovale and ductus arteriosus, either or both, are generally pervious, and the septum between the ventricles is in some instances deficient. The duration of life varies according to the amount of obstruction. In the cases given, death occurred between the ages of nine and thirty-six years.

Of the malformations preventing the heart undergoing the changes which should ensue after birth, the most important are patency of the foramen ovale and of the ductus arteriosus. These passages peculiar and essential to the circulation in fœtal life, remain patent, one or both, after birth, in most of the instances in which the ventricular septum is more or less deficient, and, in general, their patency is associated with obstruction at or near the pulmonary orifice. When the latter condition co-exists, the right ventricle frequently becomes hypertrophied, but this rule is not without exceptions. If the communication between the auricles and primary arteries be free, the right ventricle, instead of being enlarged, is sometimes found quite small, evidently atrophied, the blood finding a free outlet through the fœtal passages, thus preventing accumulation in the right ventricular cavity. It is to be remarked that although in the great majority of instances of open foramen ovale, obstruction at or near the orifice of the pulmonary artery is associated, the rule is not invariable. Hence, this obstruction, although a frequent, is not the sole cause of the persistence of the communication of the auricles after birth. Patency of the ductus arteriosus is a conservative provision in cases of obliteration of, or great obstruction at the pulmonic orifice. It is equally so in certain instances in which the foramen ovale becomes closed during fœtal life. This duct remains pervious in some cases in consequence of obstruction at the aortic orifice, and also at the left auriculo-ventricular aperture. These co-existing malformations account for the persistence of the open duct in the great majority of cases, but the latter is sometimes observed when it is not thus to be accounted for, existing independently of other abnormities to which a relation of dependency can be traced.

Under the head of "Malformations not interfering with the Functions of the Heart, but laying the Foundations of Disease in after Life," are embraced deficiency in the number of the semilunar valves on the one hand, and excess in the number of segments on the other hand. Deficiency in the number of valves is of more importance, as tending to disease, than excess. In fact, it does not appear that the latter leads to any serious consequences. The former involves, in certain cases, insufficiency and regurgitation, and, as the author thinks, a disposition of the valves to take on disease greater than if no malformation existed. Union of the different segments of the tricuspid and mitral valves is found not infrequently in autopsical examinations, and in a certain proportion of these cases it is due to disease of intra-uterine life. The proportion of cases in which the disease dates from a period anterior to birth is undoubtedly greater in the instances of union of the tricuspid than of the mitral valves, for the liability of the latter to take on disease after birth is vastly greater than that of the former. Dr. Peacock is of opinion that this difference in tendency to valvular disease between the two sides of the heart, which is so marked after birth, is reversed during fœtal life; that is, he thinks the tricuspid valves are as much more likely to take on disease before as the mitral valves are after birth.

The malformations consisting in the irregular development of the primary vessels constitute a class which, in general, are not compatible with a considerable duration of life. Extraordinary abnormities falling in this division are occasionally met with. The author cites examples of transposition of the aorta and pulmonary artery, and of the descending aorta given off from the pulmonary artery. Of sixteen cases in which one or the other of these transpositions existed, in three life was prolonged beyond the third year, death taking place in the others after a few weeks or months.

Of the causes of death in the various forms of malformation, the most frequent are—1. Cerebral disturbance resulting from the defective aeration of the blood and congestion of the brain; and, 2. Imperfect expansion, collapse, and engorgement of the lungs. It is worthy of note that serious dropsical effusions, so common in morbid lesions of the heart, occur less frequently than would be expected from the obstruction to the circulation incident to many of the malformations. Death not unfrequently occurs from tuberculosis in the cases in which life is prolonged for several years. This statement is in opposition to the doctrine laid down by Rokitansky, viz., that "all cyanoses, or rather all forms of disease of the heart, vessels, or lungs, inducing cyanosis of various kinds and degrees, are incompatible with tuberculosis, against which cyanosis affords a complete protection." Of fifty-six cases in which patients affected with different forms of malformation survived the age of eight years, in nine tuberculosis became developed, being a ratio of 16.07 per cent. This fact is striking and valuable. It should be added that in six of the nine tuberculous cases cyanosis existed in a marked degree. The fact certainly militates against the incompatibility of tuberculous disease and venosity of the blood, as asserted by Rokitansky. It is, however, certain that diseases of the heart and phthisis are not often associated. Is there a law here which is applicable to morbid conditions, and not to congenital malformations? This is a question to be settled by further statistical data.

The nature of the connection existing between cyanosis (*morbus cæruleus*) and malformations of the heart has been much discussed, and is still open for discussion. According to Morgagni, the cyanotic phenomena are attributable to general congestion of the venous system, caused by obstruction at the origin of the pulmonary artery. Hunter attributed the appearances to intermixture of venous and arterial blood in consequence of abnormal communication between either the auricles or ventricles, or both. This was the current doctrine until, within the past few years, the explanation of Morgagni has been revived by several distinguished pathologists—Louis and Valleix in France, Hasse and Rokitansky in Germany, Joy in England, and the late Dr. Moreton Stillé of this country. By none of the other writers named has the subject been discussed so fully and ably as by our countryman.[1] Many distinguished pathologists, however, still adhere to the Hunterian theory. Dr. Stillé established the fact that cyanosis may exist without the intermixture of the currents of blood. This is sufficiently established with regard to congenital malformations. It is also proved by diseases, for certainly phenomena essentially cyanotic are incident to various affections. He also established that complete intermixture of the two kinds of blood may take place without cyanosis being produced. These two points suffice to show that the connection between the occurrence of cyanosis and the admixture of venous and arterial blood is not constant enough to prove that the existence of the one involves the existence of the other. In other words, cyanosis must in some instances be due to some other cause than this. The analysis of a considerable number of cases in which the condition of the pulmonary artery was ascertained (viz., in 62), showed the existence of contraction, imperviousness, or some obstruction, in 53; and in the other cases there were conditions present which would give rise to venous congestion. These facts render it almost certain that obstruction of the circulation through the pulmonary artery may give rise to cyanosis. But do they warrant the conclusion that this obstruction is in all instances the origin of the affection, and that in no instance is it due to the admixture of venous and arterial blood? We think this question must be answered in the negative. With our present knowledge, neither the theory of Morgagni, advocated by Stillé and others, nor that of Hunter, is to be adopted to the entire exclusion of the other. The argument of Dr. Walshe, adduced by the author, possesses much force. He says:—

> "How is that doctrine (that cyanosis depends on congestion of the venous system) reconcilable with the fact that the most intense obstruction may occur in the adult without inducing true cyanotic discoloration? How comes it, too, if communication between the two sides of the heart be so unimportant, that in five only out of seventy-one cases of cyanosis collected by Stillé was such communication wanting?"

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[1] On Cyanosis, or Morbus Cæruleus. By Moreton Stillé, M. D. Amer. Journ. of the Med. Sciences, N. S., vol. viii., 1844, p. 25.

Dr. Peacock adopts the theory advocated by Dr. Stillé. He brings forward cases exemplifying, on the one hand, the production of cyanosis by malformations involving obstruction, but no communication between the two sides of the heart; and, on the other hand, the freest possible admixture without cyanotic phenomena. These facts, however, do not prove conclusively that in no instances is cyanosis due to admixture of the two kinds of blood; nor do they show that this admixture is not, in some cases at least, an important element in conjunction with obstruction to the pulmonary circulation. Much as this subject has been elucidated, there is still ample scope for further researches. The condition of the capillary vessels, it is very probable, exerts more or less influence on the production of cyanosis.

We quote the author's words with reference to this point:—

> "It is probably necessary to the production of cyanosis, that, as suggested by Dr. Chevers, the obstruction to the circulation should either have been present before birth, when the capillary vessels are naturally more capacious than in the adult; or that it should have existed before the full development of the body was attained, and while the entire vascular system was more readily dilatable; or, at least, that it should have been of long duration, so that the capillary vessels may have become greatly expanded."

To determine in early life that malformation of some kind exists, is usually not difficult, provided the abnormity be of a nature and sufficient in degree to induce marked disorder. Palpitation, dyspnœa, or cyanosis, existing from birth, or developed shortly afterwards, and either persisting or recurring more or less frequently, point clearly to a congenital difficulty. To determine the particular kind of malformation, however, is a problem in diagnosis not always easy. It is sometimes impracticable. With reference to the latter discrimination, it is important to bear in mind that out of a given number of malformations after the age of twelve years, in a very large proportion there exists contraction at the pulmonic orifice. Of 39 cases analyzed by Dr. Peacock, obstruction to the passage of blood into the pulmonary artery existed in 32. It is also to be kept in view that in a large proportion of the cases in which obstruction at the pulmonic orifice exists, either there is patency of the foramen ovale, or deficiency of the auricular or ventricular septa, or both. If pulmonic obstruction be determined, the chances are that the last-mentioned malformations coexist. Guided by the law of probabilities, if a person survive several years with manifestly some cardiac malformation, we shall seldom err in presuming that there exists pulmonic obstruction. But physical signs may convert this presumption into a conclusion almost positive. A bellows murmur referable to the pulmonary orifice points to this as the seat of an abnormal condition. That a systolic murmur may be referred to the pulmonary orifice is certain. The maximum of the intensity of the murmur will be at the base of the heart on the left side of the sternum, or the murmur may be limited to this situation. It will not be propagated into the carotids. It is highly probable that attention to the pulmonary second sound of the heart will afford additional aid in the diagnosis. In connection with a murmur referable as first stated, in a large proportion of cases there will be present the physical evidence of enlargement of the right ventricle. It is doubtful, as the author remarks, whether a regurgitant current from the pulmonary artery is ever strong enough to develop a diastolic murmur. It may possibly do so in cases in which the right ventricle is greatly hypertrophied. Communication of the two ventricles through an aperture in the septum gives rise to a murmur. A murmur thus produced will not be propagated either along the course of the aorta or pulmonary artery, and will still have its maximum of intensity at or near the base of the heart. By these points its source may be determined with considerable confidence, but not with positiveness, for intra-ventricular murmurs are occasionally incident to disease which cannot be traced either to the arterial or auriculo-ventricular orifices by the ordinary rules of localization. The passage of blood through an open foramen ovale, or a defect in the auricular septum, probably never gives rise to murmur. The clinical study of cases of malformation, with respect to the physical signs, is highly interesting, and claims more attention than it has as yet received.

The general principles of treatment in cases of malformation are embraced in a few words. They consist of measures to protect against cold; avoidance of over-exertion and great mental excitement; together with such palliative measures as the particular circumstances in individual cases may indicate.

We have embodied in this analytical review those points pertaining to malformations of the heart, contained in Dr. Peacock's work, which seem to us most interesting and important. We have done this, consulting brevity as much as possible, for the reasons stated at the outset. An additional reason is, the work may not be republished in this country, and will therefore be accessible to but few American readers. In conclusion, Dr. Peacock has displayed, in the preparation of the work, not only a thorough and philosophical acquaintance with the subject, but a tact in arrangement and condensation which it is difficult for an author to exercise. He has given a comprehensive and satisfactory exposition of existing knowledge relating to an extensive field of research, within the limits of a small volume. A. F.